CLAIMS

1. A method of producing a spread multi-filament bundle comprising the steps of: unwinding and feeding a multi-filament bundle from a yarn supplier; passing in suspension said multi-filament bundle as fed through a plurality of fluid flowing portions in succession comprising a fluid flowing spreader, said portions being disposed in series along a moving course of said multi-filament bundle; subjecting said multi-filament bundle to fluidal resistance while said bundle moving through said respective fluid flowing portions so as to bend said bundle towards a direction to which a fluid in use flows; and flowing said fluid through an interstice between any adjacent monofilaments of said bundle whose bonding is slackened due to said fluidal resistance so as to widen said interstice, thereby, promoting spreading operation on said bundle, wherein said multi-filament bundle to be subjected to said spreading operation is continuously passed through said fluid flowing portion located in an upstream side to said fluid flowing portion located in a downstream side in succession to gradually enlarge contact area between said bundle and said fluid so as to widely spread said multi-filament bundle in a progressive manner.

2. A method of producing a spread multi-filament bundle comprising the steps of: subjecting said multi-filament bundle in carriage to fluctuation of a tensile force applied to said bundle alternatively between tension and relaxation by locally and reciprocally pressing said bundle fed from a yarn supplier crosswise with regard to a moving course of said bundle; passing in suspension said multi-filament bundle moving under said fluctuation through a plurality of fluid flowing portions in succession comprising a fluid flowing spreader, said portions being disposed in series along a moving course of said multi-filament bundle; subjecting said multi-filament

bundle to fluidal resistance while said bundle moving through said respective fluid flowing portions so as to bend said bundle towards a direction to which a fluid in use flows; and flowing said fluid through an interstice between any adjacent monofilaments of said bundle whose bonding is slackened due to said fluidal resistance so as to widen said interstice, thereby, promoting spreading operation on said bundle, wherein said multi-filament bundle to be subjected to said spreading operation is continuously passed through said fluid flowing portion located in an upstream side to said fluid flowing portion located in a downstream side in succession to gradually enlarge contact area between said bundle and said fluid so as to widely spread said multi-filament bundle in a progressive manner.

3. A method of producing a spread multi-filament bundle comprising the steps of: subjecting said multi-filaments in carriage to fluctuation of a tensile force applied to said bundle alternatively between tension and relaxation by locally and reciprocally pressing said bundle fed from a yarn supplier crosswise with regard to a moving course of said bundle; passing in suspension said bundle moving under said fluctuation through a plurality of fluid flowing portions in succession comprising a fluid flowing spreader, said portions being disposed in series along said moving course of said bundle; and providing a linearly back-and-forth friction widthwise with regard to said bundle in a process of being spread, through any adjacent monofilaments of which bundle a fluid flows with said tensile force applied to said bundle fluctuated alternatively between tension and relaxation at said respective fluid flowing portions.

4. A method of producing a spread multi-filament bundle according to claim 2 wherein said multi-filament bundle unwound from said yarn supplier is fed with a restraint of being drawn back and said tensile force applied to said

bundle as restrained from being drawn back and moving to a downstream side is changed alternatively between tension and relaxation by locally and reciprocally pressing said bundle crosswise with regard to said moving course of said bundle.

5. A method of producing a spread multi-filament bundle according to claim 4 wherein a floating control bridge to secure a degree by which said bundle bends at a predetermined level is provided in said plurality of fluid flowing portions respectively such that said bundle is put into contact with a fluid under said floating control bridge so as not to make said degree by which said bundle passing through said respective fluid flowing portions bends smaller than said predetermined level.

6. A method of producing a spread multi-filament bundle according to claim 5 wherein said bundle passes in suspension through said respective fluid flowing portions respectively disposed in series along said moving course of said bundle in such a manner that a sizing agent contained in said bundle in passage is softened by heating so as to make bonding between monofilaments comprising said bundle slackened.

7. A method of producing a spread multi-filament bundle comprising the steps of: feeding a group of a number of multi-filament bundles unwound from respective yarn suppliers of a creel with aligned in parallel and in the same plane; passing in suspension said group of said multi-filament bundles respectively as fed through a plurality of fluid flowing portions in succession comprising a fluid flowing spreader, said portions being disposed in series along a moving course of said respective multi-filament bundles; subjecting said respective multi-filament bundles to fluidal resistance while said bundles respectively moving through said respective fluid flowing portions so as to bend said respective bundles towards a direction to which a fluid in use flows; and

flowing said fluid through an interstice between any adjacent monofilaments of said respective bundles whose bonding is slackened due to said fluidal resistance so as to widen said interstice, thereby, promoting spreading operation on said respective bundles; and subjecting a group of spread multi-filament bundles in carriage to fluctuation of a tensile force applied to said respective bundles alternatively between tension and relaxation by locally and reciprocally pressing said group of said spread multi-filament bundles moving in the same plane crosswise with regard to a moving course of said respective bundles, thereby, further promoting spreading operation by said respective fluid flowing portions.

8. A method of producing a spread multi-filament bundle comprising the steps of: feeding a group of a number of multi-filament bundles unwound from respective yarn suppliers of a creel with aligned in parallel and in the same plane; passing in suspension said group of said multi-filament bundles respectively as fed through a plurality of fluid flowing portions in succession comprising a fluid flowing spreader, said portions being disposed in series along a moving course of said respective multi-filament bundles; subjecting said respective multi-filament bundles to fluidal resistance while said bundles respectively moving through said respective fluid flowing portions so as to bend said respective bundles towards a direction to which a fluid in use flows; and flowing said fluid through an interstice between any adjacent monofilaments of said respective bundles whose bonding is slackened due to said fluidal resistance so as to widen said interstice, thereby, promoting spreading operation on said respective bundles; providing a linearly back-and-forth friction widthwise with regard to a group of spread multi-filament bundles moving in the same plane so as to produce a spread multi-filament bundles sheet with fringe side monofilaments of any adjacent spread bundles

tangentially aligned and monofilaments as a whole of said respective spread bundles uniformly distributed in density.

9. A method of producing a spread multi-filament bundle comprising the steps of: feeding a group of a number of multi-filament bundles unwound from respective yarn suppliers of a creel with aligned in parallel and in the same plane; passing in suspension said group of said multi-filament bundles respectively as fed through a plurality of fluid flowing portions in succession comprising a fluid flowing spreader, said portions being disposed in series along a moving course of said respective multi-filament bundles; subjecting said respective multi-filament bundles to fluidal resistance while said bundles respectively moving through said respective fluid flowing portions so as to bend said respective bundles towards a direction to which a fluid in use flows; and flowing said fluid through an interstice between any adjacent monofilaments of said respective bundles whose bonding is slackened due to said fluidal resistance so as to widen said interstice, thereby, promoting spreading operation on said respective bundles; and subjecting respective spread multi-filament bundles in carriage to fluctuation of a tensile force applied to said respective spread bundles alternatively between tension and relaxation by locally and reciprocally pressing a group of said spread multi-filament bundles moving in the same plane crosswise with regard to a moving course of said respective bundles, thereby, further promoting spreading operation by said respective fluid flowing portions; providing a linearly back-and-forth friction widthwise with regard to said group of said spread multi-filament bundles moving in the same plane so as to produce a spread multi-filament bundles sheet with fringe side monofilaments of any adjacent spread bundles tangentially aligned and monofilaments as a whole of said respective

spread bundles uniformly distributed in density.

10. An apparatus for producing a spread multi-filament bundle comprising one of a supplier and a creel provided with a number of said suppliers; a multi-filament bundle feeder to unwind one of a multi-filament bundle and a group of said multi-filament bundles from one of said supplier and said suppliers of said creel under a certain tension and to feed one of said multi-filament bundle and said group of multi-filament bundles with a restraint being drawn back while keeping one of said multi-filament bundle and said group of multi-filament bundles in a plane; a fluid flowing spreader provided with a plurality of fluid flowing portions disposed in series along a moving course of one of said bundle and said group of bundles respectively to put a fluid into contact with and pass said fluid through one of said bundle and said group of bundles with one of said bundle and said group of bundles in carriage supported in suspension, said fluid flowing crosswise with regard to said moving course; and a tensile force variable system to change a tensile force applied to one of said bundle and said group of bundles in carriage alternatively between tension and relaxation.

11. An apparatus for producing a spread multi-filament bundle according to claim 10 wherein said tensile force variable system comprises an elevating rod provided with a press roller at its lower end portion; a contractile and extensile crank arm engaged to said elevating rod; and a crank motor whose power shaft is provided with a rotor in engagement with said crank arm.

12. An apparatus for producing a spread multi-filament bundle according to claim 10 wherein a tension stabilizing mechanism is provided at an upstream side from said fluid flowing spreader, said mechanism being provided with a tension stabilizing roller to abut a multi-filament bundle unwound and fed from one of a supplier and a creel under a certain pressure and being arranged such that said

tension stabilizing roller in abutment with said bundle continues pressing said bundle so as to increase a tensile force applied to said bundle along with increasing a degree by which said bundle bends until a predetermined tensile force is applied to said bundle when said tensile force applied to said bundle decreases below said predetermined tensile force and is inferior to a pressure applied by said roller while said tension stabilizing roller in abutment with said bundles is bounced back to retract along with decreasing said degree until said predetermined tensile force is applied to said bundle when said tensile force applied to said bundle increases above said predetermined tensile force and is superior to said pressure applied by said roller so as to keep said tensile force applied to said bundle in carriage constant.

13. An apparatus for producing a spread multi-filament bundle according to claim 10 wherein a floating control bridge running crosswise with regard to said moving course of one of said bundle and said group of bundles is provided inside said respective fluid flowing portions.

14. An apparatus for producing a spread multi-filament bundle according to claim 13 wherein said floating control bridge is formed into a cylindrical shape whose middle portion diametrically bulges like an entasis.

15. An apparatus for producing a spread multi-filament bundle according to claim 10 wherein a heater is disposed above and opposite to said respective fluid flowing portions so as to apply heating treatment on one of said bundle and said group of bundles in passage.

16. An apparatus for producing a spread multi-filament bundle according to claim 10 wherein a widthwise back-and-forth friction system is disposed to provide back-and-forth friction widthwise with regard to one of said bundle and said group of bundles in a process of being spread in abutment with monofilaments comprising said one of said bundle and said group of bundles respectively.

17. An apparatus for producing a spread multi-filament bundle according to claim 10 wherein a prolonged opening provided along said moving course of one of said bundle and said group of bundles is segmented into said respective fluid flowing portions with an interval.

18. An apparatus for producing a spread multi-filament bundle according to claim 10 wherein said plurality of fluid flowing portions respectively are of a diametrically enlarged watertight tube, on an entrance side and an exit side of which respective portions a yarn passage hole is provided, said watertight tube being provided with a liquid circulation passage through a circulation pipe connected to a circulation pump, an operation of which pump causes circulating water to circulate through at a flow velocity as required said respective fluid flowing portions via said circulation pipe to subject one of said bundle and said group of bundles to water resistance so as to bend said one of said bundle and said group of bundles passing through said yarn passage holes of said respective fluid flowing portions towards a direction to which said circulating water flows, through an interstice between adjacent monofilaments of one of said bundle and said group of bundles respectively said circulating water flows so as to widen said interstice.